Dec. 2, 1952 | C. I. LONGENECKER | 2,619,913

ROTARY CONCRETE PUMP

Filed Oct. 14, 1948 | 2 SHEETS—SHEET 1

Fig. 1.

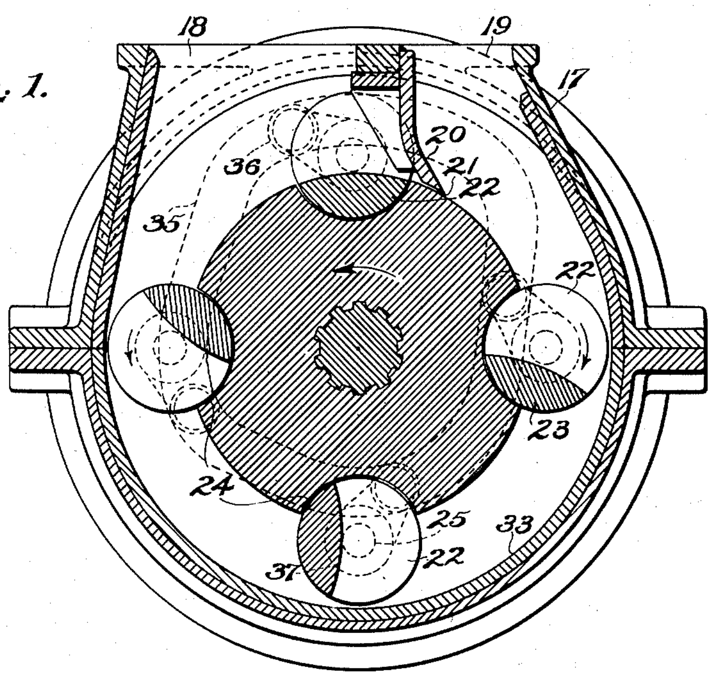
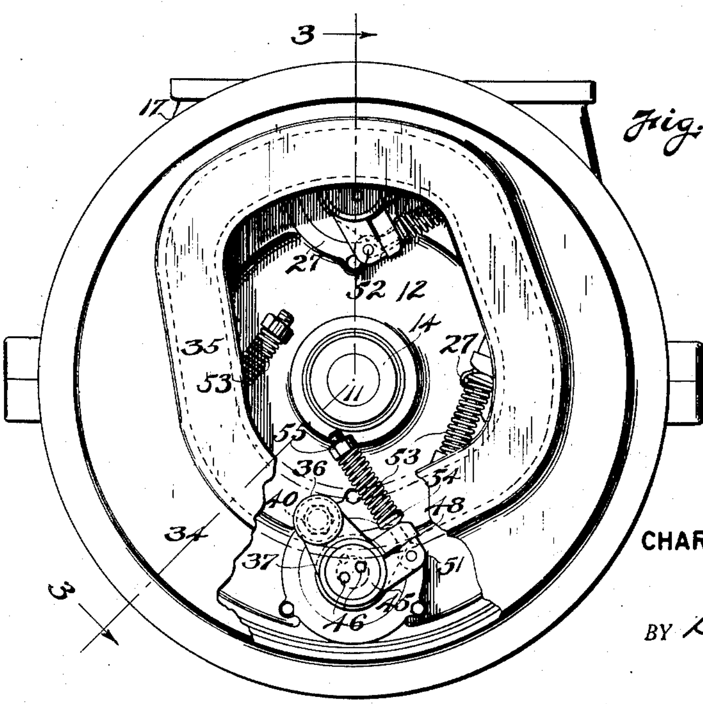


Fig. 2.



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Filed Oct. 14, 1948 2 SHEETS—SHEET 2

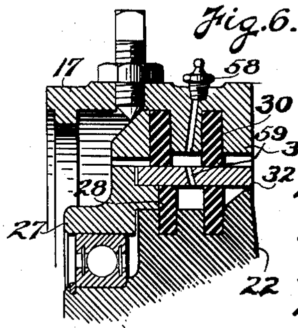

Fig. 6.

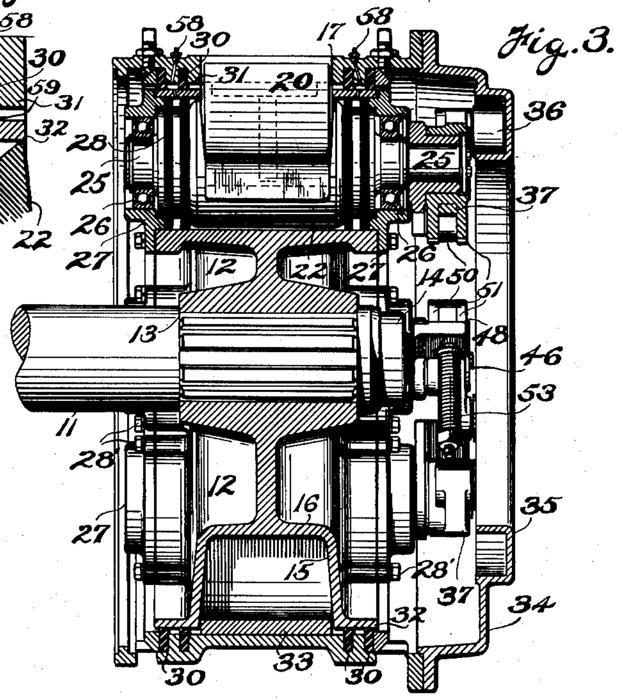

Fig. 3.

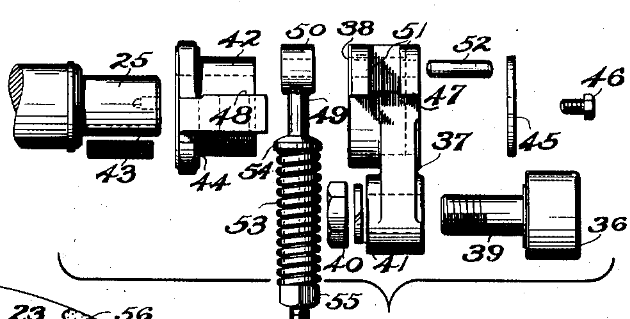

Fig. 5.

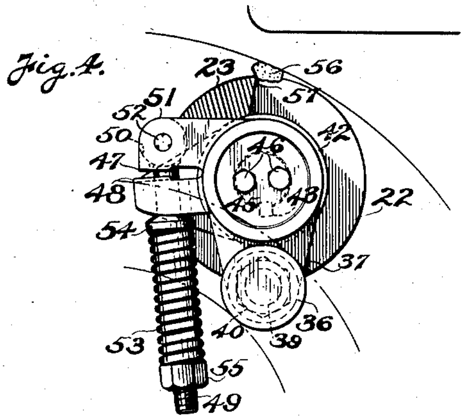

Fig. 4.

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Patented Dec. 2, 1952 **2,619,913**

UNITED STATES PATENT OFFICE

2,619,913

ROTARY CONCRETE PUMP

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Application October 14, 1948, Serial No. 54,371

8 Claims. (Cl. 103—140)

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Attempts have been made in the past to propel concrete through a pipeline under the influence of pressure created by rotary pumps and a number of patents have been issued disclosing apparatus which purports to accomplish this objective. None of these pumps have ever successfully passed the experimental stage, and the reason they have not is believed to reside in the fact that these pumps did not take fully into consideration the peculiarities of concrete as a pumpable medium.

This invention is directed to the provision of a rotary pump in which the elements are arranged and operated in a manner that will enable the machine to pump concrete.

A rotary pump has a number of advantages in pumping concrete as well as other materials, arising principally from its light weight, large capacity and simplified construction. These advantages are particularly advantageous for concrete pumping systems since the only existing successful concrete pump, which is of the reciprocating piston type, is both heavy and expensive by comparison.

With a reciprocating piston pump, the mass of concrete in the pipeline comes to rest at each reciprocation of the piston, whereas with a rotary pump, the flow is continuous enabling the use of longer pipelines without building up excessive pressure.

Reduction of the size of the pump is likewise of great importance since it enables the pump to be utilized in confined quarters where the present reciprocating piston type pump cannot be employed.

According to the present invention, a more or less conventional arrangement of rotor and stator is used, with oscillating or vibrating impeller members mounted on the rotor to function in a generally well known manner. Peculiarities of construction arise from the requirement of maintaining within the working chamber pressure which may be well in excess of 100 lbs. per sq. inch, created by a moving stream of material which embodies stones and the other coarse, abrasive constituents of a concrete mixture. Unless the pump can run efficiently for a reasonably long period of time without the replacement of wearing parts, it is not a practical tool for the placement of concrete.

One of the features of this invention is the provision of a rotary pump in which the impeller members are caused to move between two extreme positions during the rotation of the pump, but the drive of the impellers in one direction,

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i. e., toward non-impelling position, is positive, whereas the drive in the opposite direction, as the impeller members are brought into operating position, is yieldable to a limited extent should the impeller members encounter an obstruction such as a stone in the concrete being pumped.

It is highly important that the impeller members be required to move in order that their tendency to stick in the presence of a pasty material such as concrete may not be aggravated, and by this invention, while travel is limited in one direction to a certain predetermined extent, it is positive up to that point, and it is also positive in return, and hence the parts cannot "freeze" in any one position. In practice the amount of relief or overtravel that is permitted during the movement of the impeller members into the rotor runner is of the same order as the largest stone permitted in the concrete being pumped.

While the impeller members are yieldably driven in one direction as indicated above, the arrangement of these members and their operation is such that the yielding of one of the impellers under such circumstances does not impair the efficiency of the pump or create channelling of the concrete in the working chamber. This results from the improbability of two successive impeller members each encountering a similar obstruction, the nature of concrete as a semi-plastic fluid, and the drive of the impeller members as aforesaid, all cooperating to maintain a steady, substantially uniform, rate of flow of concrete through the pipeline.

The invention is illustrated in the accompanying drawings wherein:

Fig. 1 is an end elevation taken in section through the center of the impeller members;

Fig. 2 is an end elevation looking in the opposite direction from Fig. 1, with parts broken away to illustrate the impeller actuating mechanism;

Fig. 3 is a section taken on line **3—3** of Fig. 2;

Fig. 4 is an enlarged view of one of the impeller actuating mechanisms;

Fig. 5 is an exploded side elevation of the mechanism shown in Fig. 4; and

Fig. 6 is a section showing an enlargement of elements shown in Fig. 3.

In the drawings, the shaft **11**, driven by any suitable source of power, has splined thereon the cylindrical rotor **12**, which is prevented from moving axially of the shaft by the shoulder **13** on one side of the rotor and by the lock nut **14** on the other side. The cross sectional shape of the rotor is best illustrated in Fig. 3 from which it will be apparent, as illustrated in the lower portion of said figure, that the outwardly extending, substantially radial flanges 15, combined with the rotor's intermediate cylindrical surface 16, constitutes a runner in which material is propelled through the pump.

Enclosing the rotor runner is the housing generally designated 17 which may be mounted on a skid base or a vehicle as the occasion demands. The housing 17 has an inlet opening 18 and an outlet 19 separated by a stripping element 20, best illustrated in Fig. 1. By providing the inlet 18 above the rotor, gravity is utilized to facilitate charging of the pump, while the location of the outlet 19, also above the rotor and adjacent the inlet, makes possible the use of substantially the entire volume of the rotor runner as a working chamber.

The stripping element 20 corresponds in shape to the cross section of the rotor and substantially occupies the same, with the edge 21 of the stripper adjacent the cylindrical surface 16 of the rotor curved to conform closely thereto.

The rotor 12 carries four movable impeller members 22, each being identical in construction and in method of mounting and operation. The impellers 22 are cylindrical plugs having a central channel portion 23 so that when in one position, the opening which the channel portion provides corresponds to the cross section of the rotor runner and enables the impellers to pass the stripping element 20 without interference. In this position, the impeller is substantially wholly recessed in the rotor, the rotor having four axial grooves 24 in its periphery to accommodate the entire solid, central portion of the respective impeller members.

Extending from either side of the impellers are trunnions 25 journalled in bearings 26 carried by hub brackets 27 bolted on the sides of the rotor 12. The rotor 12 is somewhat wider than the cylindrical portion of the impeller members, and as a result, the side flanges 15 of the rotor are bored out to accommodate the ends of the impellers and the sealing members 28 disposed therebetween. This construction enables the removal of the impellers by sliding them endwise following the removal of the bolts 28′ and the bearing brackets 27 which these bolts retain.

The disposition of the seals 28 is best illustrated in Fig. 6, wherein there is also shown the seals 30 which are located between the stator portion 31 of the housing 17 and the two edges of the rotor runner, the latter having outwardly turned cylindrical flanges 32 against which the seals 30 bear during rotation of the rotor. A replaceable lining member 33 mounted on the inside of the stator extends into the rotor runner a slight distance and reduces the amount of throw of the impeller members necessary to bring the latter into operating proximity with the stator.

For operating the impeller members, a dish-shaped flange 34 is mounted on the back of the housing 17 and carries integral therewith a stationary channel-shaped cam track 35 in which the individual rollers 36 associated with each of the impeller members are adapted to ride. Each roller 36 is journalled on a rock arm 37 having a hub portion 38, which is free to turn on an axis concentric with the axis of the impeller. In the present instance, the roller 36 is integral with a stud 39, the threaded end of which cooperates with a nut 40 and lock washer 41 to retain the stud in its journal in the arm 37.

The hub 38 is journalled on a second hub 42 locked on the trunnion 25 of the impeller member by a key 43. Hub 38 is retained against axial movement on hub 42 by the shoulder 44 on the latter, and by the cap 45, which is retained by bolts 46 threaded into the end of the trunnion 25.

Hubs 38 and 42 have abutting surface portions 47 and 48 respectively, causing the impeller member to oscillate positively in one direction under guidance of the roller 36 operating in the cam track 35. The abutting surface 48 on the hub 42 constititutes a lever arm for driving the impeller member. Operation of the impeller member in the opposite direction is effected by a bolt 49 which has an eye portion 50 arranged between two ears 51, the sides of which constitute the abutting surface 47 of the hub 38. The bolt 49 is free to pivot about a pin 52 (likewise retained by the cap 45) extending through its eye portion and apertures in the ears 51. The bolt 49 extends through an aperture in the abutment 48 and the extending portion carries a compression spring 53 disposed between a washer 54 and a bolt nut 55. The spring 53 provides yieldability in the drive of the impeller member from its recessed position to its position adjacent the stator by permitting overtravel of the cam arm through the compression of the spring. In Fig. 4 this function is illustrated, the abutting members 47 and 48 being spread apart due to the presence of a stone 56 between the forward edge 57 of the impeller and the stator lining 33. The amount of overtravel that is permitted can be predetermined by the selection of the spring and the adjustment of the nut 55 on the bolt 49.

As soon as any appreciable amount of concrete has been propelled through the outlet 19 into the pipeline extending therefrom, pressure starts to build up in the working chamber defined by the stripper 20 and the forward faces of the respective impellers 22, as the latter move into full impelling position. This pressure is transmitted against the seals 28 and 30, which are constantly lubricated through the fitting 58 leading through the stator to the space between the rotor seals 28.

Openings 59 are provided in the axial flanges 32 extending outward from the ends of the flanges 15 of the rotor (see Fig. 6), so that lubricant fed to the rotor seals 30 may be transmitted to the impeller seals 28 during operation of the pump. Clearances between the rotor runner and either the stripper or the impeller faces provide only slight pressure relief because of the packing tendency of concrete making these clearances ineffective for relief purposes. Hence the seals must withstand the high pressures created in the chamber if the pressure in the pipeline is to be overcome and the material pumped an appreciable distance.

The overlapping relation of the replaceable liner 33 to the flanges 15 of the rotor is a factor in prolonging the life of the seals 28 because of the restricted space through which grout may pass before entering the seals in the pressure portion of the pump opposite the stripper. With lubricant constantly fed under pressure into the space between the seals 30, a film of lubricant is formed in the spaces between the liner and the rotor, thereby inhibiting the setting up of grout in this region. By occupying a portion of the runner, the liner 33 also enables the bi-directional cam 35 to bring the impellers into full impelling position in a shorter period of time with less throw of the impeller drive means.

The position of the impeller members with respect to the rotor and the stator during the operation of the pump is illustrated in Fig. 1 wherein it will be seen that as each impeller member passes the stripping element 20, it is recessed within the rotor. Thereafter the cam guideway causes rapid oscillation of the aforesaid impeller counterclockwise, as viewed in said figure, so that shortly after rotating through 90° the forward edge 57 of the impeller is adjacent the liner 33. The latter position is maintained until the rotor has travelled through nearly 270°, at which time the impeller is oscillated in the reverse, or clockwise direction, to cause it to be again wholly recessed within the rotor as it passes the stripping element. Some clearance is preferably provided between the edge 57 and the stator liner 33 at all times, and while this clearance may be increased by the compression of the spring 53 in case an obstruction such as a stone is encountered, the movement of the concrete through the working chamber is continuous, for there is no time when there are not two impeller members in full impelling position and the probability of a stone interfering with movement of two successive impellers is practically negligible. If the forward of two impellers is prevented from going into full impelling position, the following impeller will propel the entire channel of concrete ahead of it, including the most peripheral portion which is not acted upon by the preceding impeller.

The invention having been described, what is claimed is:

1. A rotary pump comprising a stator with an inlet and an outlet and a stripping element therebetween, a rotor spaced from the stator, means confining the ends of the space between the stator and rotor, said rotor having circumferentially spaced impeller members arranged to propel material from the inlet through said space to the outlet of the stator, means for imparting motion to the impeller members to cause them to travel seriatim and with equally positive force in each direction between a position in which they are substantially wholly recessed in the rotor when they are opposite the stripping element and a second position where they are substantially adjacent the stator, and yieldable means limiting travel of the impeller members a predetermined extent when encountering an obstruction during travel to said second position, said means being inoperative during return of said members to recessed position.

2. A rotary pump comprising a stator with an inlet and an outlet and a stripping element therebetween, a rotor spaced from the stator, means confining the ends of the space between the stator and rotor, said rotor having circumferentially spaced impeller members cooperable with said stripping element to propel material from the inlet to the outlet, means for imparting motion to the impeller members to cause them to travel seriatim and with equally positive force in each direction from a position in which they are substantially wholly recessed in the rotor to a second position where they are substantially adjacent the stator, and connections between the motion imparting means and the impeller members providing lost motion during a portion of such travel should the impeller encounter an obstruction, said connection providing positive drive during the entire travel of said members to recessed position.

3. A rotary pump comprising a stator with an inlet and an outlet and a stripping element therebetween, a rotor spaced from the stator, means confining the ends of the space between the stator and rotor, said rotor having circumferentially spaced impeller members mounted therein arranged to oscillate seriatim between a position in which they are substantially wholly recessed in the rotor when they are opposite the stripping element and a second position where they are substantially adjacent the stator, cam means for operating the impeller members, and driving means connecting the cam means and the impeller members providing an equally positive drive of the impeller members during travel of said members to and from recessed position, including overtravel linkage operable over a limited portion of such travel during movement of said members to a position adjacent the stator.

4. A rotary pump comprising a stator with an inlet and outlet and a stripping element therebetween, a rotor spaced from the stator, means confining the ends of the space between the stator and rotor, said rotor having circumferentially spaced impeller members mounted therein arranged to oscillate between a first position in which they are substantially wholly recessed in the rotor when they are opposite the stripping element and a second position where they are substantially adjacent the stator, a stationary bidirectional operating cam track, a cam follower arranged in said track, a connection between the cam follower and the impeller members offset with respect to the axes of the latter to produce equally positive oscillatory movement of the impeller members in both directions of travel, including over-travel linkage operable for a limited portion of such travel during movement of said members to a position adjacent the stator, and means for varying the amount of such overtravel.

5. A rotary concrete pump comprising a stator with an inlet and outlet and a stripping element therebetween, a rotor spaced from the stator, means confining the ends of the space between the stator and rotor, said rotor having circumferentially spaced impeller members mounted therein arranged to propel concrete through said space from the inlet to the outlet, each of said impellers having a movable drive shaft, a cam for imparting motion to the impeller members to cause them to oscillate from a position in which they are substantially wholly recessed in the rotor when they are opposite the stripping element to a second position where they are substantially adjacent the stator, a lever arm rigid with the impeller drive shaft, a rock arm supported by and pivotal about the axis of the impeller shaft, a cam follower mounted by said rock arm cooperable with said cam, abutting means carried by said arms causing positive drive in one direction, and spring means providing a yieldable connection between said arms while imparting motion in the other direction.

6. In a rotary pump for pumping semi-plastic material such as concrete, a rotor having a cylindrical surface and substantially radial flanges, a stator concentric with said cylindrical surface and spaced therefrom, said stator confining the ends of said flanges to provide a working chamber, impeller members having cylindrical end portions arranged to oscillate within aligned recesses provided in said rotor flanges, sealing means disposed between the ends of the impeller members and the enclosing portions of the rotor flanges, sealing means disposed between the rotor and the

stator, means to provide lubricant to the rotor seals, and means to transmit lubricant from the rotor seals to the impeller seals during operation of the pump.

7. A rotary pump for pumping semi-plastic material such as concrete comprising a rotor having a cylindrical surface and substantially radial flanges, a stator enclosing the space between said flanges to provide a pumping chamber and having an inlet and an outlet and a stripper therebetween, a liner member mounted on the stator opposite the stripper, said liner member overlapping and extending between the rotor flanges in closely disposed juxtaposed relation thereto, impeller members having cylindrical end portions arranged to oscillate within aligned recesses provided in the rotor flanges, and means for oscillating the impeller members during movement of the rotor from a position adjacent the stripper to a position adjacent the liner to maintain a pressure chamber communicating with the outlet of the pump.

8. A rotary pump comprising a rotor, a stator concentric with said rotor providing a working chamber therebetween, means confining the ends of said chamber, said stator having an inlet and an outlet and a stripper, impeller members mounted for oscillatory movement in the rotor, a bi-directional cam, cam followers, linkage connecting said followers with the respective impeller members producing equally positive movement of the impellers in each direction of travel,

and springs providing overtravel of the linkage should its associated impeller encounter an obstruction, said cam being arranged to maintain at least two impelling members in impelling position at all times, whereby obstruction of one impeller enables the following impeller to maintain pressure in the portion of the working chamber communicating with the outlet of the pump.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
48,604	Umholtz	July 4, 1865
549,255	Reichhelm	Nov. 5, 1895
1,012,642	Hughes	Dec. 26, 1911
1,324,260	Meyer	Dec. 9, 1919
2,151,484	Nordling	Mar. 21, 1949
2,157,141	Murray	May 9, 1939
2,168,779	Murray	Aug. 8, 1939
2,247,429	Aikman	July 1, 1941
2,338,112	Hell	Jan. 4, 1944
2,374,445	McFarland	Apr. 24, 1945

FOREIGN PATENTS

Number	Country	Date
3,065	Great Britain	1861
243,352	Italy	1926
590,729	France	Mar. 25, 1925